Down Syndrome Research and Practice **6**(3), 134-138

Characterisation of the somatic evolution of Portuguese children with Trisomy 21 - Preliminary results

Armando Fernandes[1], Ana Paula Mourato[1], Mª João Xavier[2], David Andrade[3], Cláudio Fernandes[4] and Miguel Palha[1]

[1] *Child Development Centre of the Paediatric Department of Hospital de Santa Maria, Lisbon*

[2] *Paediatric Department of Hospital São Francisco Xavier, Lisbon*

[3] *Faculty of Dental Medicine of Oporto*

[4] *Trainee Assistant of the Mathematics Department of the University of Science and Technology of New University of Lisbon*

Abstract — We present preliminary results of a cross-sectional study which had the following objectives: 1- to develop percentile curves of weight, height and head circumference of Portuguese children with Trisomy 21 from 0 to 48 months of age; 2- a comparison of the growth of children with Trisomy 21 with a control population of their siblings, and 3- a comparison between the growth of Portuguese and American children with Trisomy 21 (based on the data of Cronk *et al*). We conclude that: 1- there is growth delay (weight, height, head circumference) in the Portuguese children with Trisomy 21, in all of the parameters evaluated and in all age groups; 2- Portuguese children with Trisomy 21 present values similar to those obtained by Cronk *et al* until 24 months of age; 3- from the age of 30 months onward Portuguese children with Trisomy 21 were heavier and taller than American children with Trisomy 21. This supports the usefulness of percentile curves specifically for Portuguese children with Trisomy 21.

Keywords — Down syndrome, growth curves, Trisomy 21, Portugal

Introduction

Children with Trisomy 21 have well documented growth retardation, particularly with respect to head circumference.

In clinical paediatrics, and particularly in development disturbances, somatometric records (weight, height and head circumference) may be of value in supporting the diagnosis of a wide variety of disorders which effect people with Trisomy 21.

Portugal has a population of approximately ten million inhabitants, and extrapolating from the statistical findings of other countries, a prevalence of 10 to 15 thousand people with Trisomy 21 could be expected. This corresponds to 150 to 180 children born each year with this condition.

The main objectives of this study were: 1- to develop percentile curves of somatic development (weight, height and head circumference) for Portuguese children with Trisomy 21, from 0 to 48 months of age; 2- the comparative study of growth of children with Trisomy 21 with a population drawn from their siblings; 3- and a comparison between the growth of Portuguese and American children with Trisomy 21 (Cronk *et al.*, 1988).

Material and Methods

Based on some of the approaches in the literature (Cronk *et al.*, 1988; Piro *et al.*, 1990; Lin *et al.*, 1991; Cremers *et al.*, 1996), we designed, in 1995, a cross-sectional study with standards which would allow clear presentation of percentile curves for weight, stature and head circumference of Portuguese children with Trisomy 21, important starting points for the development of a prospective study.

Most information was obtained during the evaluation of children with Trisomy 21 at the outpatient clinic for Trisomy 21 at the Development Centre of the Paediatric Department at Saint Maria Hospital and/or from the outpatient clinic of the Child Health Bulletin (previous files of children with Trisomy 21, aged from 0 to 10 years).

Population

The study involved a population of Portuguese children with Trisomy 21 and their siblings with ages between 0 and 48 months followed at the Trisomy 21 Outpatient clinic.

 ISSN: 0968-7912
http://www.down-syndrome.net/library/periodicals/dsrp/06/03/

The population consisted of: 1) 196 children with Trisomy 21, representing approximately 32% of Portuguese children with Trisomy 21 aged between 0 and 48 months (551.060 *(1/900) = 612), from all parts of the country, thus forming a significant sample of the Portuguese children with Trisomy 21, 0 to 48 months old (none of whom were institutionalised); and 2) 96 siblings of children with Trisomy 21, without known disorders.

Methods

The following approaches were used:

1 Retrospective collection of anthropometric data registered in the Child Health Bulletins (children with Trisomy 21 with their respective siblings) and/or measurement, performed by one of the team members, suitably trained, during the evaluation of the development of children with Trisomy 21 followed at the Trisomy 21 clinic. Only the files with measurements taken within one week of the key dates were considered (key dates 0, 3, 6, 9, 12, 15, 18, 24, 30, 36, 42 and 48 months).

2 Grouping of anthropometric data studied by gender and age, for children with Trisomy 21 and respective siblings.

(months)		Boys n	Boys mean	Boys SD	Girls n	Girls mean	Girls SD
0	Weight	107	3.024	0.55	91	2.911	0.52
	Height	107	47.71	1.96	91	47.13	2.24
	HC	107	33.07	1.30	91	32.58	1.30
3	Weight	104	5.090	0.74	91	4.623	0.86
	Height	104	57.34	2.77	91	56.06	3.20
	HC	104	38.46	1.33	91	37.58	1.40
6	Weight	100	6.847	0.95	87	6.328	1.08
	Height	100	64.11	2.59	87	62.29	3.21
	HC	100	41.38	1.35	87	40.57	1.30
9	Weight	95	7.925	1.00	78	7.478	1.20
	Height	95	68.01	2.68	78	66.96	3.35
	HC	95	42.91	1.35	78	42.23	1.40
12	Weight	94	8.677	1.01	78	8.534	1.10
	Height	94	71.24	3.00	78	70.48	3.10
	HC	94	43.97	1.35	78	43.36	1.31
15	Weight	77	9.337	1.01	59	9.148	1.10
	Height	77	74.23	3.58	59	73.46	3.40
	HC	77	44.68	1.42	59	44.10	1.20
18	Weight	73	10.112	1.26	55	9.984	1.21
	Height	73	76.94	3.77	55	76.18	3.89
	HC	73	45.35	1.42	55	44.86	1.20
24	Weight	63	11.135	1.26	51	11.184	1.49
	Height	63	81.11	4.10	51	80.74	4.50
	HC	63	46.26	1.38	51	45.81	1.17
30	Weight	53	12.070	1.49	45	12.170	1.50
	Height	53	85.40	4.10	45	86.37	4.50
	HC	-	-	-	-	-	-
36	Weight	39	12.816	1.50	41	13.188	1.60
	Height	39	88.20	4.00	41	89.84	4.50
	HC	-	-	-	-	-	-
42	Weight	31	13.550	1.54	33	14.220	1.64
	Height	31	90.2	4.70	33	92.43	4.60
	HC	-	-	-	-	-	-
48	Weight	27	14.938	1.63	26	15.073	1.82
	Height	27	94.95	5.70	26	96.73	4.92
	HC	-	-	-	-	-	-

Table 1. Summary of anthropometric data - Children with Trisomy 21.
Abbreviations: HC = Head Circumference
Note: The units of measurement are kilograms for weight and centimetres for height and HC

Age (months)		Boys with Tri. 21 n	Boys with Tri. 21 mean	Boys with Tri. 21 SD	Brothers n	Brothers mean	Brothers SD	p
0	Weight	107	3.024	0.55	55	3.247	0.48	< 0.05
	Height	107	47.71	1.96	55	49.46	2.42	< 0.01
	HC	107	33.07	1.30	55	35.18	1.50	< 0.01
3	Weight	104	5.090	0.74	55	6.068	0.80	< 0.01
	Height	104	57.34	2.77	55	59.57	3.16	< 0.01
	HC	104	38.46	1.33	55	40.84	1.50	< 0.01
6	Weight	100	6.847	0.95	50	7.989	1.18	< 0.01
	Height	100	64.11	2.59	50	66.82	3.21	< 0.01
	HC	100	41.38	1.35	50	43.76	1.50	< 0.01
9	Weight	95	7.925	1.00	44	9.314	1.33	< 0.01
	Height	95	68.01	2.68	44	72.10	3.21	< 0.01
	HC	95	42.91	1.35	44	45.49	1.68	< 0.01
12	Weight	94	8.677	1.01	44	10.271	1.60	< 0.01
	Height	94	71.24	3.00	44	76.12	3.23	< 0.01
	HC	94	43.97	1.35	44	46.68	1.77	< 0.01
15	Weight	77	9.337	1.01	34	11.023	1.62	< 0.01
	Height	77	74.23	3.58	34	79.38	3.27	< 0.01
	HC	77	44.68	1.42	34	47.51	1.77	< 0.01
18	Weight	73	10.112	1.26	33	11.677	1.66	< 0.01
	Height	73	76.94	3.77	33	82.22	3.50	< 0.01
	HC	73	45.35	1.42	33	47.98	2.00	< 0.01
24	Weight	63	11.135	1.26	30	12.900	1.80	< 0.01
	Height	63	81.11	4.10	30	87.44	4.25	< 0.01
	HC	63	46.26	1.38	30	49.20	1.90	< 0.01
30	Weight	53	12.070	1.49	28	14.074	1.90	< 0.01
	Height	53	85.40	4.10	28	92.40	2.27	< 0.01
	HC	-	-	-	-	-	-	-
36	Weight	39	12.816	1.50	28	15.094	1.96	< 0.01
	Height	39	88.20	4.00	28	96.84	4.30	< 0.01
	HC	-	-	-	-	-	-	-
42	Weight	31	13.550	1.54	22	15.945	2.01	< 0.01
	Height	31	90.2	4.70	22	100.53	4.80	< 0.01
	HC	-	-	-	-	-	-	-
48	Weight	27	14.938	1.63	22	17.030	2.20	< 0.01
	Height	27	94.95	5.70	22	104.04	5.80	< 0.01
	HC	-	-	-	-	-	-	-

Table 2. Comparison between boys with Trisomy 21 and their respective brothers

 ISSN: 0968-7912
http://www.down-syndrome.net/library/periodicals/dsrp/06/03/

3 Adjustment of the subgroups obtained, using the Kolmogorov-Smirnov test.

4 Homogenisation of the subgroups, excluding extreme values (mean plus or minus 4 standard deviations).

5 Estimation of the mean value and standard deviation of all the parameters in the different subgroups.

6 The data was plotted according to the different anthropometric parameters, to derive the percentiles curves 5%, 10%, 25%, 50%, 75%, 90% and 95%. Smoothing of the percentile curves was performed using the cubic 'spline' method.

7 Comparison between the group of children with Trisomy 21 and their siblings, using Student's t test.

8 Comparison between the average of Portuguese and American children with Trisomy 21.

Data analysis

The data was introduced in a database specially developed for such a study using Microsoft Access. The analysis of data and the graphs were done in a spreadsheet (Microsoft Excel) and using various statistical and graphical programs (DataFit, Dplot, Graphically, Statistica, SPSS).

We considered values of $p<0.05$ to be statistically significant.

Results

The results obtained are presented in Tables 1, 2 and 3.

The percentile curves for weight, length/stature, and head circumference of Portuguese children with Trisomy 21 are represented in Figures 1 to 6.

We found statistically significant differences between our children with Trisomy 21 and their siblings in all of the measures and in all age groups (Tables 2 and 3).

Discussion

The use of reference charts for the monitoring of weight, height and head circumference changes, is at present a familiar routine to the majority of health professionals involved in child care, and also, increasingly to many parents. The concept of percentile curve is easily understood and these data may help in the clinical diagnosis of many

Age (months)		Girls with *Tri. 21* n	mean	SD	Sisters n	mean	SD	p
0	Weight	91	2.911	0.52	41	3.371	0.46	< 0.01
	Height	91	47.13	2.24	41	49.36	1.55	< 0.01
	HC	91	32.58	1.30	41	34.68	1.34	< 0.01
3	Weight	91	4.623	0.86	39	5.627	0.92	< 0.01
	Height	91	56.06	3.20	39	59.26	2.57	< 0.01
	HC	91	37.58	1.40	39	40.64	1.49	< 0.01
6	Weight	87	6.328	1.08	39	7.306	0.90	< 0.01
	Height	87	62.29	3.21	39	65.99	2.67	< 0.01
	HC	87	40.57	1.30	39	43.32	1.49	< 0.01
9	Weight	78	7.478	1.20	37	8.599	1.03	< 0.01
	Height	78	66.96	3.35	37	70.84	2.61	< 0.01
	HC	78	42.23	1.40	37	45.03	1.49	< 0.01
12	Weight	78	8.534	1.10	36	9.645	1.03	< 0.01
	Height	78	70.48	3.10	36	74.69	3.02	< 0.01
	HC	78	43.36	1.31	36	46.49	1.49	< 0.01
15	Weight	59	9.148	1.10	32	10.540	1.14	< 0.01
	Height	59	73.46	3.40	32	78.11	2.99	< 0.01
	HC	59	44.10	1.20	32	47.57	1.49	< 0.01
18	Weight	55	9.984	1.21	32	11.341	1.19	< 0.01
	Height	55	76.18	3.89	32	81.38	3.11	< 0.01
	HC	55	44.86	1.20	32	47.98	1.49	< 0.01
24	Weight	51	11.184	1.49	29	12.759	1.49	< 0.01
	Height	51	80.74	4.50	29	87.66	3.01	< 0.01
	HC	51	45.81	1.17	29	49.32	1.5	< 0.01
30	Weight	45	12.170	1.50	28	13.935	1.67	< 0.01
	Height	45	86.37	4.50	28	92.85	3.67	< 0.01
	HC	-	-	-	-	-	-	-
36	Weight	41	13.188	1.60	26	14.832	2.03	< 0.01
	Height	41	89.84	4.50	26	95.94	4.90	< 0.01
	HC	-	-	-	-	-	-	-
42	Weight	33	14.220	1.64	23	15.594	2.40	< 0.05
	Height	33	92.43	4.60	23	97.68	5.15	< 0.01
	HC	-	-	-	-	-	-	-
48	Weight	26	15.073	1.82	22	16.806	2.70	< 0.05
	Height	26	96.73	4.92	22	102.56	5.50	< 0.01
	HC	-	-	-	-	-	-	-

Table 3. Comparison between girls with Trisomy 21 and their respective sisters.

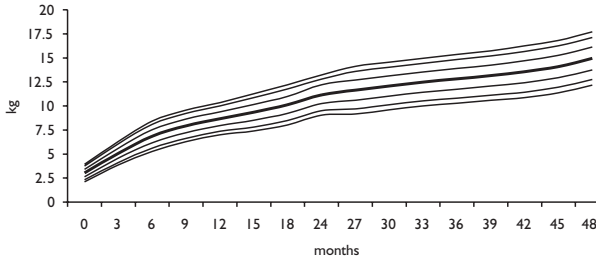

Figure 1. Percentile curves for weight of male Portuguese children with Trisomy 21.

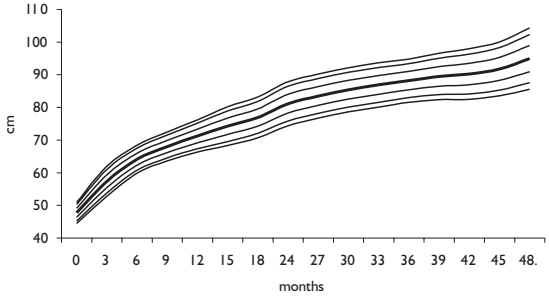

Figure 2. Percentile curves for height of male Portuguese children with Trisomy 21

 ISSN: 0968-7912
http://www.down-syndrome.net/library/periodicals/dsrp/06/03/

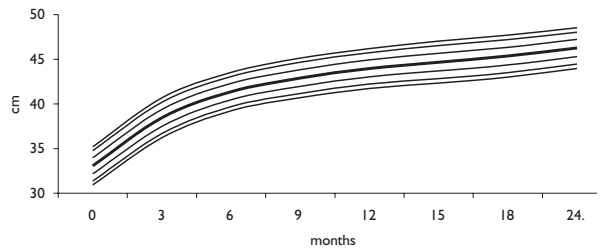

Figure 3. Percentile curves for head circumference of male Portuguese children with Trisomy 21.

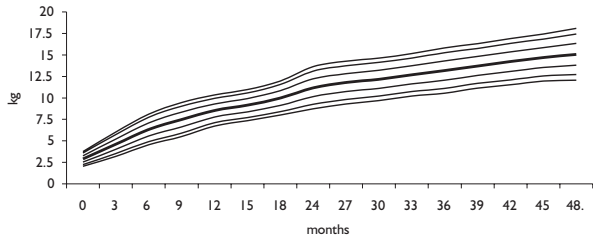

Figure 4. Percentile curves for weight of female Portuguese children with Trisomy 21.

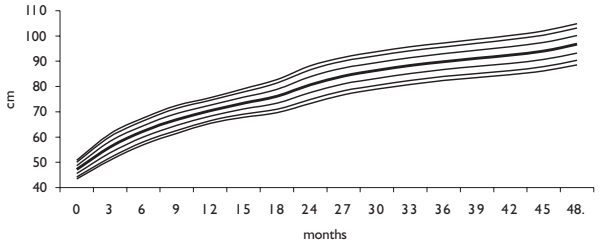

Figure 5. Percentile curves for height of female Portuguese children with Trisomy 21.

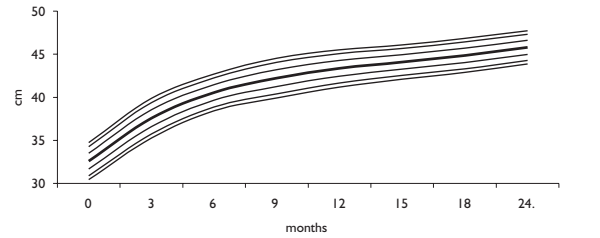

Figure 6. Percentile curves for head circumference of female Portuguese children with Trisomy 21.

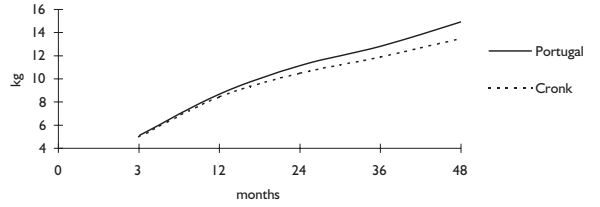

Figure 7. Comparison between the medians of weight of male Portuguese and American children with Trisomy 21 (Cronk et al, 1988).

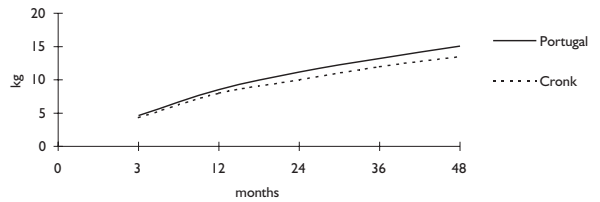

Figure 8. Comparison between the medians of height of male Portuguese and American children with Trisomy 21 (Cronk et al, 1988).

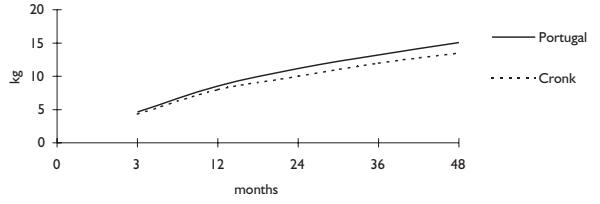

Figure 9. Comparison between the medians of weight of female Portuguese and American children with Trisomy 21 (Cronk et al, 1988).

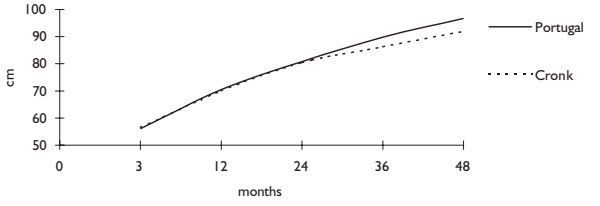

Figure 10. Comparison between the medians of height of female Portuguese and American children with Trisomy 21 (Cronk et al, 1988).

conditions which may affect the psychomotor development of Trisomy 21 population.

Standard reference charts are inadequate for many children, especially those with constitutional growth disturbances. Many of the situations are rare, which may transform the task of creating a growth chart difficult, if not impossible (Hulse, 1988).

Concerning Trisomy 21, much has been written (Cronk *et al.*, 1988; Piro *et al.*, 1990; Lin *et al.*, 1991; Cremers *et al.*, 1996; Hulse, 1988); however, the growth charts by Cronk *et al.* (1988) are the ones best known and used. Other percentile charts have been published, partly because the charts by Cronk *et al.* do not perfectly adapt to children with Trisomy 21 from other countries (Piro *et al.*, 1990; Lin *et al.*, Cremers *et al.*, 1996).

 ISSN: 0968-7912
http://www.down-syndrome.net/library/periodicals/dsrp/06/03/

In this study, we present the preliminary results for Portuguese children with Trisomy 21. The percentile curves for weight and/or height cover the ages between 0 and 48 months. Due to lack of data on head circumference for children of ages equal to or above 30 months, we decided to present only the percentile curves from 0 to 24 months groups.

There are statistical significant differences between our children with Trisomy 21 and their siblings in all of the somatic parameters evaluated and in all age groups. This fact may be due to the genetic differences between these children with Trisomy 21 and their kin, and/or endocrinologic and metabolic disturbances (maturation delay and/or hypothalamic dysfunction leading to partial deficit of growth hormone and/or growth 'insulin-like' factors) in the children with Trisomy 21 (Annerén *et al*., 1990).

When comparing the mean values of the weight and height of Portuguese and American children with Trisomy 21 (Cronk *et al*., 1988), we confirmed that the results are similar up to 24 months of age, after which Portuguese children present slightly higher values (Figures 7 to 10). This may be partly due to the genetic differences between the two populations studied and the time delay between both studies. Therefore, the development of percentile charts for Portuguese children with Trisomy 21 is justified.

Acknowledgements

We wish to thank all of the children evaluated, as well as the parents of children with Trisomy 21 for their collaboration as well as the financial support given by the Commission for Investigation in Health Care.

We would also like to thank Dr. Susan Marum for the English translation of the present article.

Correspondence

Armando Fernandes, Child Development Centre of the Paediatric Department, Hospital de Santa Maria, Av. Prof. Egas Moniz, 1599 Lisbon, Portugal, E-mail: amrf@mail.telepac.pt

References

Annerén, G., Gustavson, K-H., Sara, V.R. & Tuvemo, T. (1990). Growth retardation in Down syndrome in relation to insulin-like growth factors and growth hormone. *American Journal of Medical Genetics*, 7, 59-62.

Cremers, M.J.G., Tweel, I., Boersma, B., Wit, J.M. & Zonderland (1996). Growth curves of Dutch children with Down's syndrome. *Journal of Intellectual Disability Research*, 40, 412-20.

Cronk, C., Crocker, A.C., Pueschel, S.M., Shea, A.M., Zackai, E., Pickens, G. *et al* (1988). Growth charts for children with Down syndrome: 1 month to 18 years. *Pediatrics*, 81, 102-10.

Hulse, J.A. (1988). Special growth charts. *Archives of Disease in Childhood*, 63, 1179-80.

Lin, S.J., Hu, S.C., Sheu, S.F., Ho, J.W., Chiou, P.C., Chao, M.C. *et al* (1991). Anthropometric study on Down syndrome in Taiwan. *Acta Paediatrica Sin*, 32, 158-64

Piro, E., Pennino, C., Cammarata, M., Corsello, G., Grenci, A., Giudice, C. *et al* (1990). Growth charts of Down Syndrome in Sicily: Evaluation of 382 children 0-14 years of age. *American Journal of Medical Genetics*, Suppl 7, 66-70.

 ISSN: 0968-7912
http://www.down-syndrome.net/library/periodicals/dsrp/06/03/